required number of pixels has been found to drop to about one-fourth that required using current art, while avoiding the moire and noise current art uses the exit pixels to avoid. When the implications of this are seen on all aspects of image calculation, transmission and storage in science, medicine and entertainment, the fundamental importance of this invention is apparent.

Turning now to FIGS. **19**A–F, the advantages of using a sinc filter is quantified for image antialiasing a conventional interpolative anti-alias filter. The frequency response of the interpolation is an offset cosine wave. FIG. **19**B reflects the aliases caused by sampling with the filter of FIG. **19**A. These aliases undercut the remaining signal. FIG. **19**C arbitrarily defines quality as gain minus competing aliases. FIG. **19**E is equivalent to FIG. **19**C except for the use of a perfect sinc filter, thereby having a flat response with no undercutting aliases.

Image information content is proportional to frequency. A 501×501 image contains 251,001 pixels, 1001 more pixels than a 500×500 image, but a 1001×1001 image contains 1,002,001 pixels, 2001 more pixels than a 1000×1000 image. The same frequency increment is "worth" twice as much at twice the frequency. FIG. **19**D multiples quality by frequency to give the information, as shown in black. This directly transforms equality to equivalent pixel count.

Now compare the Information with an ideal sinc filter as shown in FIG. **19**F with that in FIG. **19**D to see a rather startling result. The ideal filtering has nearly tripled the information contained in a fixed number of pixels. The applicant has found by empirical experimentation that by using the methods of this invention, either the image quality is tripled, or equivalent image quality can be preserved by using less than half the number of pixels. This is a significant finding and a very important advance to the art of digital image processing and storage applied to fields as diverse as medical imaging and the motion picture industry.

This invention applies two steps of resize to go from the "array resolution", or "A resolution" to the final output "chosen resolution", or "B resolution", as illustrated in FIGS. **16**, **17**A, **17**B, and **17**C. The step from A to B resolution is made with a normal convolution window similar to an interpolative window to provide good computation speed and reasonable suppression of aliases at the expense of frequency response. The frequency response is corrected and the aliases clipped in going from B to C resolutions with a much more computationally intensive sinc filter. This can be afforded because the B resolution has far fewer points following the prefilter.

In the preferred embodiment of the scanner, for reasons explained above, the linearity from the sensor is preserved through all the processing steps. The square root, more commonly called "gamma correction", is done after the resizing steps. This is opposite from convention which applies the gamma correction immediately after the sensor. Processing in linear space does require more bits to be retained per sample.

The process of resizing is shown in more detail in FIG. **16**. Because the array A resolution pixel spacing **500** is determined by motor speed, it can vary depending on the speed at which tile host is accepting data. If this were to be resized directly to the output resolution using a wide window filter, such as a sinc filter mentioned earlier, three problems are encountered that add considerably to the required computation time. First, the wide width of the window requires many points to be input into the convolution. Second, because the spacing is not fixed, the filter impulse response must be computed as needed or stored at high resolution and the appropriate point calculated and recalled matching each array pixel. Third, because the spacing between input pixels can vary over the width of the impulse, each pixel must be individually weighted in inverse proportion to that spacing.

These problems are solved in the current invention by resizing in two steps. The impulse array of the first step is chosen to maximize the ratio between signal to alias using the narrowest possible window. The absolute frequency response is not critical because attenuation of high frequencies can be compensated by modifying the second filter, thereby freeing the frequency response as a constraint on the first filter.

The impulse response chosen to resize the A resolution **500** of FIG. **17**A into the B resolution **501** of FIG. **17**B is a triangle **502**. In space, this is the convolution of two equal square responses, and therefore in frequency it has a response that is the product of two equal sinc functions, curve **502** in FIG. **17**B. The window width (the radius of the triangle) was chosen as the width between B resolution pixels **501** to place a gain of exactly zero at the sampling frequency. As a further expedient, the triangle **502** was approximated in steps to further speed calculations using the algorithm described earlier.

This triangle response gives good attenuation of aliases, in fact at twice the Nyquist frequency, the attenuation approaches zero as the square of the distance from twice Nyquist, a double zero as shown in FIG. **17**B. The triangle response does however soften desired frequencies, attenuating up to 50% at the Nyquist frequency. Because the signal is digital, and because good signal to alias ratios are maintained, this attenuation is no problem because the response can be recovered in the final filter.

The impulse response of the final filter **505** between the B resolution pixels **501** and C resolution pixels **507** is a modified sinc function **505** that boosts high frequencies in inverse proportion to the losses in the first filter, and losses in the sensor and lens of the scanner. Such a complex wide window filter can be afforded at this point because the number of points input to the filter at the B resolution **501** is considerably less than that of the A resolution **500**, the prefilter has made the spacing of pixels at the B resolution **501** roughly fixed and therefore points of the impulse response **505** can be recalled by incrementation by a constant of a pointer into an array holding the impulse response, and each point can be weighted the same.

FIGS. **17**A–**17**C illustrate what this multiple pass accomplishes in the frequency domain. FIG. **17**A shows a possible response **509** for the array and optics. In the prior art, there was always a compromise between sharpness, leading to excess aliases, or a reduction of aliases through blurring. This invention accepts neither compromise by using oversampling of the physical array coupled with resizing in the digital domain where a precise response can be defined.

In FIG. **17**B, the triangular impulse **502** has been applied to the array pixels resulting in the attenuated response **503**. Calculations are made only at the discrete points of the B resolution **501**, called sample points, and their spacing is called the sampling frequency. The Nyquist frequency is half the sampling frequency, and is the maximum frequency that can be reproduced with that sample spacing if every other point is positive and interstitial points are negative. Sampling theory says that frequencies that pass beyond the Nyquist frequency **511** reflect back as false frequencies or "aliases" **513**. The alias curve **513** is a mirror image of that portion of the response curve **503** that extends beyond the